



**Billing Code 4910-13**

**DEPARTMENT OF TRANSPORTATION**

**Federal Aviation Administration**

**14 CFR Part 25**

**[Docket No. FAA-2018-0293; Special Conditions No. 25-723-SC]**

**Special Conditions: Textron Aviation Inc. Model 700 Series Airplanes; Interaction of Systems and Structures**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions; request for comments.

**SUMMARY:** These special conditions are issued for the Textron Aviation Inc. (Textron) Model 700 series airplanes. These airplanes will have novel or unusual design features when compared to the state of technology envisioned in the airworthiness standards for transport category airplanes. These design features are systems that affect structural performance, either directly or as a result of a failure or malfunction. The influence of these systems and their failure conditions must be taken into account when showing compliance with the FAA's requirements. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for these design features. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** This action is effective on Textron Aviation Inc. on [INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]. Send comments on or before [INSERT DATE 45 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**ADDRESSES:** Send comments identified by Docket No. FAA-2018-0293 using any of the following methods:

- *Federal eRegulations Portal:* Go to <http://www.regulations.gov/> and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE, Room W12-140, West Building Ground Floor, Washington, DC, 20590-0001.
- *Hand Delivery or Courier:* Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at 202-493-2251.

*Privacy:* The FAA will post all comments it receives, without change, to <http://www.regulations.gov/>, including any personal information the commenter provides. Using the search function of the docket website, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the *Federal Register* published on April 11, 2000 (65 FR 19477-19478).

*Docket:* Background documents or comments received may be read at <http://www.regulations.gov/> at any time. Follow the online instructions for accessing the docket or go to Docket Operations in Room W12-140 of the West Building Ground Floor

at 1200 New Jersey Avenue, SE, Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Greg Schneider, Airframe and Cabin Safety Section, AIR-675, Transport Standards Branch, Policy and Innovation Division, Aircraft Certification Service, Federal Aviation Administration, 2200 South 216th Street, Des Moines, Washington 98198; telephone 206-231-3213; e-mail [Greg.Schneider@faa.gov](mailto:Greg.Schneider@faa.gov).

**SUPPLEMENTARY INFORMATION:** The substance of these special conditions previously has been published in the **Federal Register** for public comment. These special conditions have been derived without substantive change from those previously issued. It is unlikely that prior public comment would result in a significant change from the substance contained herein. Therefore, the FAA has determined that prior public notice and comment are unnecessary, and finds that, for the same reason, good cause exists for adopting these special conditions upon publication in the **Federal Register**.

### **Comments Invited**

We invite interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

We will consider all comments we receive by the closing date for comments. We may change these special conditions based on the comments we receive.

## **Background**

On November 20, 2014, Textron applied for a type certificate for their new Model 700 series airplanes. The Textron Model 700 series airplanes are transport-category, twin turbofan-powered airplanes with standard seating provisions for up to 12 passengers and 2 crewmembers, and a maximum takeoff weight of 39,500 lbs.

## **Type Certification Basis**

Under the provisions of title 14, Code of Federal Regulations (14 CFR) 21.17, Textron must show that the Model 700 series airplanes meet the applicable provisions of part 25, as amended by amendments 25-1 through 25-141.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the Textron Model 700 series airplanes because of novel or unusual design features, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design features, these special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the Textron Model 700 series airplanes must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36.

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type certification basis under § 21.17.

## **Novel or Unusual Design Features**

The Textron Model 700 series airplanes will incorporate the following novel or unusual design features:

These airplanes are equipped with systems (i.e. with flight control systems, autopilots, stability augmentation systems, load alleviation systems, flutter control systems, fuel management systems, etc.) that, directly or as a result of failure or malfunction, affect its structural performance.

## **Discussion**

Current regulations do not take into account the effects of systems on structural performance including normal operation and failure conditions. Special conditions are needed to account for these features. These special conditions define criteria to be used in the assessment of the effects of these systems on structures. The general approach of accounting for the effect of system failures on structural performance is extended to include any system in which partial or complete failure, alone or in combination with other system partial or complete failures, would affect structural performance.

These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

## **Applicability**

As discussed above, these special conditions are applicable to the Textron Model 700 series airplanes. Should Textron apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, these special conditions would apply to that model as well.

## **Conclusion**

This action affects only certain novel or unusual design features on one model series of airplanes. It is not a rule of general applicability.

## **List of Subjects in 14 CFR Part 25**

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

## **Authority Citation**

The authority citation for these special conditions is as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40113, 44701, 44702, 44704.

## **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Textron Aviation Inc. Model 700 series airplanes.

## **Interaction of Systems and Structures**

For airplanes equipped with systems that affect structural performance, either directly or as a result of a failure or malfunction, the influence of these systems and their failure conditions must be taken into account when showing compliance with the requirements of title 14, Code of Federal Regulations (14 CFR) part 25, subpart C and D.

The following criteria must be used for showing compliance with these special conditions for airplanes equipped with flight control systems, autopilots, stability augmentation systems, load alleviation systems, flutter control systems, fuel management systems, and other systems that either directly, or as a result of failure or malfunction, affect structural performance. If these special conditions are used for other systems, it may be necessary to adapt the criteria to the specific system.

1. The criteria defined herein only addresses the direct structural consequences of the system responses and performances and cannot be considered in isolation but should be included in the overall safety evaluation of the airplane. These criteria may, in some instances, duplicate standards already established for this evaluation. These criteria are only applicable to structures whose failure could prevent continued safe flight and landing. Specific criteria that define acceptable limits on handling characteristics or stability requirements when operating in the system degraded or inoperative mode are not provided in these special conditions.
2. Depending upon the specific characteristics of the airplane, additional studies may be required that go beyond the criteria provided in these special conditions in order to demonstrate the capability of the airplane to meet other realistic conditions, such as alternative gust or maneuver descriptions for an airplane equipped with a load alleviation system.
3. The following definitions are applicable to these special conditions:
  - a. Structural performance: Capability of the airplane to meet the structural requirements of 14 CFR part 25.
  - b. Flight limitations: Limitations that can be applied to the airplane flight conditions following an in-flight occurrence and that are included in the flight manual (e.g., speed limitations, avoidance of severe weather conditions, etc.).
  - c. Operational limitations: Limitations, including flight limitations that can be applied to the airplane operating conditions before dispatch (e.g., fuel, payload and Master Minimum Equipment List limitations).

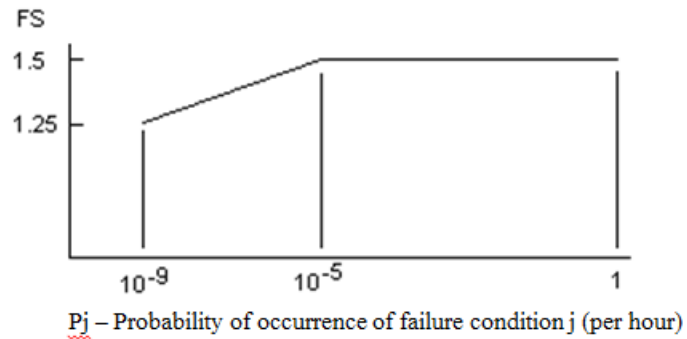
- d. Probabilistic terms: The probabilistic terms (probable, improbable, extremely improbable) used in these special conditions are the same as those used in § 25.1309.
  - e. Failure condition: The term failure condition is the same as that used in § 25.1309, however these special conditions apply only to system failure conditions that affect the structural performance of the airplane (e.g., system failure conditions that induce loads, change the response of the airplane to inputs such as gusts or pilot actions, or lower flutter margins).
4. General. The following criteria will be used in determining the influence of a system and its failure conditions on the airplane structure.
5. System fully operative. With the system fully operative, the following apply:
- a. Limit loads must be derived in all normal operating configurations of the system from all the limit conditions specified in 14 CFR part 25, subpart C (or defined by special condition or equivalent level of safety in lieu of those specified in part 25, subpart C), taking into account any special behavior of such a system or associated functions or any effect on the structural performance of the airplane that may occur up to the limit loads. In particular, any significant nonlinearity (rate of displacement of control surface, thresholds or any other system nonlinearities) must be accounted for in a realistic or conservative way when deriving limit loads from limit conditions.
  - b. The airplane must meet the strength requirements of 14 CFR part 25 (static strength, residual strength), using the specified factors to derive



ultimate loads from the limit loads defined above. The effect of nonlinearities must be investigated beyond limit conditions to ensure the behavior of the system presents no anomaly compared to the behavior below limit conditions. However, conditions beyond limit conditions need not be considered when it can be shown that the airplane has design features that will not allow it to exceed those limit conditions.

- c. The airplane must meet the aeroelastic stability requirements of § 25.629.
6. System in the failure condition. For any system failure condition not shown to be extremely improbable, the following apply:
- a. At the time of occurrence. Starting from 1-g level flight conditions, a realistic scenario, including pilot corrective actions, must be established to determine the loads occurring at the time of failure and immediately after failure.
    - i. For static strength substantiation, these loads, multiplied by an appropriate factor of safety that is related to the probability of occurrence of the failure, are ultimate loads to be considered for design. The factor of safety (FS) is defined in Figure 1.

**Figure 1**  
**Factor of safety at the time of occurrence**



- ii. For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in subparagraph (6)(a)(i). For pressurized cabins, these loads must be combined with the normal operating differential pressure.
  - iii. Freedom from aeroelastic instability must be shown up to the speeds defined in § 25.629(b)(2). For failure conditions that result in speeds beyond  $V_C / M_C$ , freedom from aeroelastic instability must be shown to increased speeds, so that the margins intended by § 25.629(b)(2) are maintained.
  - iv. Failures of the system that result in forced structural vibrations (oscillatory failures) must not produce loads that could result in detrimental deformation of primary structure.
- b. For the continuation of the flight. For the airplane, in the system failed state and considering any appropriate reconfiguration and flight limitations, the following apply:

i. The loads derived from the following conditions (or defined by special condition or equivalent level of safety in lieu of the following conditions) at speeds up to  $V_C / M_C$ , or the speed limitation prescribed for the remainder of the flight, must be determined:

(1) the limit symmetrical maneuvering conditions specified in § 25.331 and in § 25.345.

(2) the limit gust and turbulence conditions specified in § 25.341 and in § 25.345.

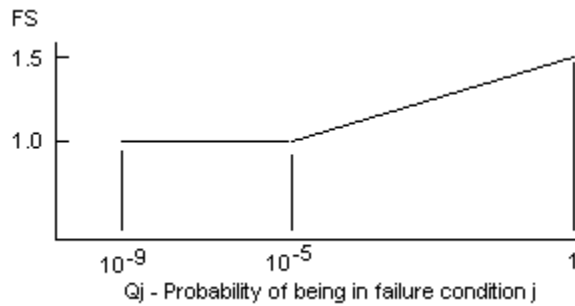
(3) the limit rolling conditions specified in § 25.349 and the limit unsymmetrical conditions specified in § 25.367 and § 25.427(b) and (c).

(4) the limit yaw maneuvering conditions specified in § 25.351.

(5) the limit ground loading conditions specified in §§ 25.473, 25.491, 25.493(d) and 25.503.

ii. For static strength substantiation, each part of the structure must be able to withstand the loads in paragraph (6)(b)(i) of the special condition multiplied by a factor of safety depending on the probability of being in this failure state. The factor of safety is defined in Figure 2.

**Figure 2**  
**Factor of safety for continuation of flight**



$Q_j = (T_j)(P_j)$  where:

$T_j$  = Average time spent in failure condition j (in hours)

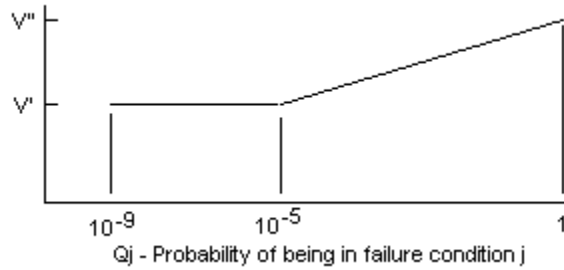
$P_j$  = Probability of occurrence of failure mode j (per hour)

**Note:** If  $P_j$  is greater than  $10^{-3}$  per flight hour then a 1.5 factor of safety must be applied to all limit load conditions specified in Subpart C.

- iii. For residual strength substantiation, the airplane must be able to withstand two thirds of the ultimate loads defined in paragraph (6)(b)(ii) of the special condition. For pressurized cabins, these loads must be combined with the normal operating differential pressure.
- iv. If the loads induced by the failure condition have a significant effect on fatigue or damage tolerance then their effects must be taken into account.
- v. Freedom from aeroelastic instability must be shown up to a speed determined from Figure 3. Flutter clearance speeds  $V'$  and

$V''$  may be based on the speed limitation specified for the remainder of the flight using the margins defined by § 25.629(b).

**Figure 3**  
**Clearance speed**



$V' =$  Clearance speed as defined by § 25.629(b)(2).

$V'' =$  Clearance speed as defined by § 25.629(b)(1).

$Q_j = (T_j)(P_j)$  where:

$T_j =$  Average time spent in failure condition  $j$  (in hours)

$P_j =$  Probability of occurrence of failure mode  $j$  (per hour)

**Note:** If  $P_j$  is greater than  $10^{-3}$  per flight hour, then the flutter clearance speed must not be less than  $V''$ .

vi. Freedom from aeroelastic instability must also be shown up to  $V'$  in Figure 3 above, for any probable system failure condition combined with any damage required or selected for investigation by § 25.571(b).

c. Consideration of certain failure conditions may be required by other sections of 14 CFR part 25 regardless of calculated system reliability.

Where analysis shows the probability of these failure conditions to be less than  $10^{-9}$  per flight hour, criteria other than those specified in this

paragraph may be used for structural substantiation to show continued safe flight and landing.

7. Failure indications. For system failure detection and indication, the following apply:

- a. The system must be checked for failure conditions, not extremely improbable, that degrade the structural capability below the level required by part 25 or significantly reduce the reliability of the remaining system. As far as reasonably practicable, the flight crew must be made aware of these failures before flight. Certain elements of the control system, such as mechanical and hydraulic components, may use special periodic inspections, and electronic components may use daily checks, in lieu of detection and indication systems to achieve the objective of this requirement. These certification maintenance requirements must be limited to components that are not readily detectable by normal detection and indication systems and where service history shows that inspections will provide an adequate level of safety.
- b. The existence of any failure condition, not extremely improbable, during flight that could significantly affect the structural capability of the airplane and for which the associated reduction in airworthiness can be minimized by suitable flight limitations, must be signaled to the flight crew. For example, failure conditions that result in a factor of safety between the airplane strength and the loads of 14 CFR part 25, subpart C, below 1.25, or flutter margins below  $V''$ , must be signaled to the crew during flight.

8. Dispatch with known failure conditions. If the airplane is to be dispatched in a known system failure condition that affects structural performance, or affects the reliability of the remaining system to maintain structural performance, then the provisions of this special condition must be met, including the provisions of paragraph (5) for the dispatched condition, and paragraph (6) for subsequent failures. Expected operational limitations may be taken into account in establishing  $P_j$  as the probability of failure occurrence for determining the safety margin in Figure 1. Flight limitations and expected operational limitations may be taken into account in establishing  $Q_j$  as the combined probability of being in the dispatched failure condition and the subsequent failure condition for the safety margins in Figures 2 and 3. These limitations must be such that the probability of being in this combined failure state and then subsequently encountering limit load conditions is extremely improbable. No reduction in these safety margins is allowed if the subsequent system failure rate is greater than  $10^{-3}$  per flight hour.

Issued in Des Moines, Washington.

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